Food Chemistry **24** (1987) 21–27

Biochemical and Nutritional Evaluation of *Egreria radiata* (Clam), A Delicacy of Some Riverine Peasant Populations in Nigeria

E. T. Ifon & I. B. Umoh

Department of Biochemistry, College of Medical Sciences,
University of Calabar, Calabar, Nigeria

(Received 24 February 1986; revised version received 10 July 1986;
accepted 29 August 1986)

ABSTRACT

Proximate, mineral and amino acid analyses of the edible portion of clam (Egreria radiata), *a delicacy of some riverine peasant populations in Nigeria, were carried out. The protein quality of the delicacy was also evaluated in a rat bioassay. Crude protein content was* $61{\cdot}0 \pm 0{\cdot}81\%$*; crude fat,* $19{\cdot}0 \pm 0{\cdot}33\%$*; carbohydrate,* $1{\cdot}40 \pm 0{\cdot}02\%$*; crude fibre,* $0{\cdot}40 \pm 0{\cdot}00\%$*, and ash,* $17{\cdot}4 \pm 0{\cdot}51\%$*. Among the essential amino acids assayed, valine, with a chemical score of* $37{\cdot}5\%$*, appeared to be the most limiting, as others had scores of over* 55%*, when compared with the essential amino acid pattern of whole hen's egg. Elemental analyses showed that, of the trace elements, clam was rich in iron, zinc and manganese, and also contained reasonable amounts of other elements. The PER, NPU, TD and BV were* $2{\cdot}55 \pm 0{\cdot}35$*,* $65{\cdot}7 \pm 1{\cdot}80$*,* $85{\cdot}3 \pm 3{\cdot}90$ *and* $77{\cdot}1 \pm 3{\cdot}35$*, respectively. These values compared reasonably well with those for whole hen's egg. The high nutritional qualities of the edible portion of clam justify its consumption and also recommend its wider use as a cheap good source of animal protein.*

INTRODUCTION

Protein energy malnutrition (PEM) is rampant in Nigeria, especially in the low income rural population and urban slums. With the present world economic depression, and that of Nigeria in particular, it is anticipated that the malnutrition situation might worsen as a result of the high cost of living. Since the prospect of improving dietary protein quality through

Food Chemistry 0308-8146/87/$03·50

increased animal production is far fetched, the need for efficient utilization of available food resources has been advocated (Pellet & Young, 1980). Recent studies have highlighted a good number of lesser known animal foods which usually form part of some traditional dishes whose consumption is within a limited population (Umoh & Bassir, 1977; Umoh *et al.*, 1980; Mba, 1980). The restrictive nature of the consumption pattern of these foods, and, in some cases, their complete neglect, stems in part from the paucity of information on their nutritional potentials. One lesser known source of protein in the peasant Nigerian diet is the clam (*Egreria radiata*). Clam is more of a delicacy than a regular dietary ingredient among some riverine populations in Nigeria. At present it is widely recognised more for the economic value of its shell than for the nutritive value of its edible portion. The present studies aim at elucidating the nutritive potentials of the edible portion of clam.

MATERIALS AND METHODS

Collection and preparation of samples for analyses

Live samples of clam (*Egreria radiata*) were bought at the open market in Calabar and conveyed to our laboratory within a few hours for processing. The samples were steeped in hot water for a few minutes to enable easy separation of the bivalved shell. The edible portion of clam was removed and incised bilaterally to expose the contents of the 'stomach' which were eventually flushed out with tap water. The water was allowed to drain before the samples were dried to constant weight in an oven pre-set at 60°C. The dry samples were milled into powder to pass through a 30-mesh sieve, and stored in a refrigerator.

Proximate composition analysis

Analyses of the fresh samples for moisture (and hence dry matter) and the dry powdered samples for crude protein (sample – N × 6·25), crude fat, crude fibre and ash were carried out using the methods of AOAC (1975). The carbohydrate content was obtained by subtracting the sum of protein, fat, crude fibre and ash from total dry matter. Analyses were done in quadruplicate.

Amino acid analysis

The quantitative estimation of amino acids was carried out on an automatic amino acid analyser based on the principles of Spackman *et al.* (1958).

Mineral element analysis

The dry powdered samples were prepared for mineral analysis by wet oxidation (Walsh, 1971). Sodium and potassium were estimated by flame photometry, while the other elements were assayed by atomic absorption spectrophotometry.

Rat bioassay

Twenty albino rats of the Wistar strain weighing between 50 and 60 g, obtained from our animal house, were used for the studies. These were divided into two groups of ten rats each consisting of five males and five females. Each group had similar average body weight. The rats were housed individually in well ventilated perspex cages with facilities for separate collection of faeces and urine. The first group was fed on a non-protein diet with the composition reported in Table 1. The 10% protein clam diet was prepared by replacing the corn starch by an adequate amount of the dry powdered clam sample to supply 10 g crude protein (N × 6·25) per 100 g diet. This diet was fed to the rats in the second group. To each group of rats, food and water were supplied *ad libitum*. The feeding lasted 10 days but records of food consumption and body weight changes, as well as faeces collection, were made during the last seven days. At the end of the feeding experiment, the nitrogen (N)—and hence crude protein (N × 6·25)—contents of the diets, as well as carcass and faecal nitrogen of individual experimental rats, were determined using standard methods (Ifon, 1980). Bioevaluation of dietary protein was based on the assessment of the

TABLE 1
Composition of Experimental Diet

Ingredient	*Percentage*
Corn starch[a]	65·00
Sucrose[b]	10·00
Glucose[b]	5·00
Alphacell[a]	5·00
Vegetable oil[c]	10·00
Mineral premix[a]	4·00
Vitamin premix[a]	1·00

[a] Nutritional Biochemicals, Cleveland, Ohio, USA.
[b] BDH Chemicals Ltd, Poole, Great Britain.
[c] Lesieur Corn Oil, Boulogue Cedex, France.

following parameters: Protein Efficiency Ratio, PER (National Academy of Sciences/National Research Council, 1963); Net Protein Ratio, NPR (Bender & Doell, 1957); Net Protein Utilization, NPU (Miller & Bender, 1955); True Digestibility, TD (Mitchell, 1923–24) and Biological Value, BV (FAO, 1965).

RESULTS AND DISCUSSION

Table 2 shows the proximate nutrient composition of clam (*Egreria radiata*). This delicacy of the peasants of the riverine regions of southern Nigeria is quite rich in crude protein, crude fat and total ash, these being 61·0 ± 0·81%, 19·8 ± 0·33 and 17·4 ± 0·51%, respectively. The crude protein value compares very favourably with the values obtained for periwinkle (*Littorina littorea*) (60·9%) and snail (*Vivapara quadrata*) (65·3%), although it is higher than the figure obtained for whole hen's egg by Umoh & Bassir (1977). The ether extractable material of *Egreria radiata* (19·8%) was higher in value than similar extracts of *Littorina littorea* (2·34%) and *Vivapara quadrata* (3·10%), but lower than that of whole hen's egg (40·2%) (Umoh & Bassir, 1977). The high ash content of *Egreria radiata* (17·4%) compared with the values of other delicacies such as *Vivapara quadrata* (4·10%) and *Littorina littorea* (8·40%) is worth noting, particularly its nutritional implication for pregnant women who have a high craving for this food.

The mineral composition of *Egreria radiata* is shown in Table 3. The values of sodium (33 mg%), potassium (46·3 mg%), magnesium (58·8 mg%), zinc (6·43 mg%), manganese (3·53 mg%), copper (0·96 mg%) and iron (27·0 mg%) were similar in most cases to results obtained by Umoh & Bassir (1977) and Mba (1980) for such other delicacies as *Littorina littorea* and *Vivapara quadrata* whose values were 40·0 mg% each for iron, 277 mg% and 24 mg% for magnesium, 28 mg% and 64 mg% for sodium,

TABLE 2
Proximate Composition of *Egregeria radiata* (Clam)

Constituent	% (*Dry matter*)[a]
Dry matter (% fresh weight)	18·5 ± 1·31
Crude protein	61·0 ± 0·81
Crude fat	19·8 ± 0·33
Carbohydrate	1·4 ± 0·02
Crude fibre	0·4 ± 0·00
Ash	17·4 ± 0·51

[a] Mean of four determinations ± SD.

TABLE 3
Mineral Element Composition of *Egreria radiata* (Clam)

Mineral element	*mg/100 g (Dry matter)*[a]
Sodium	33·0 ± 0·53
Potassium	46·0 ± 1·31
Magnesium	58·0 ± 2·11
Manganese	3·53 ± 0·04
Zinc	6·43 ± 0·14
Copper	0·96 ± 0·03
Iron	27·0 ± 0·84

[a] Mean of four determinations ± SD.

50 mg% and 51 mg% for potassium, 33·2 mg% and 2·48 mg% for copper and 3·22 mg% and 1·61 mg% for manganese. The importance of these mineral elements, particularly the trace elements, in the nutrition of the peasants cannot be over-emphasized, especially in the villages and the urban slums where there is abundant evidence of anaemia arising from gastroenteritis, hookworm and similar ailments which precipitate iron, copper and other trace mineral element deficiencies.

In Table 4, the amino acid pattern of this lesser known protein source is presented and compared with that of whole hen's egg reported by Mba (1980). All the amino acids determined, including the essential ones, were present in much lower quantities than in the whole hen's egg except histidine. Among the essential amino acids assayed, valine, with a chemical score of 37·5%, appeared to be the most limiting. Others had chemical scores of 55% and above when compared with the essential amino acid pattern of whole hen's egg. Proline was found only in trace quantity in this food.

Table 5 shows the results obtained in the rat bioassay of *Egreria radiata* compared with that of whole hen's egg reported by Umoh *et al.* (1980). The figures for PER (2·55), NPU (65·7), TD (85·3), NPR (3·55) and BV (77·1) were high, although lower than similar figures reported for whole hen's egg. These high nutritional indices fully indicate the high potentials of *Egreria radiata* as food. The PER value of 2·55 was much higher than that reported by Umoh *et al.* (1980) for such delicacies of the Nigerian peasants as *Littorina littorea* (0·70) and *Vivapara quadrata* (1·10). The TD values were similar, being 85·3% for *Egreria radiata*, 80·4% for *Littorina* and 85·9% for *Vivapara quadrata*. The values of 77·1% for BV and 65·7 for NPU for *Egreria* were high and indicative of the high nutritional value of this lesser known foodstuff. Our results on the evaluation of the nutritional potentials of *Egreria radiata* have confirmed the high nutritional quality of this

TABLE 4
Amino Acid Composition of *Egreria radiata* (Clam) Compared with Whole Hen's Egg (g/16 gN)

Amino acid	Egreria radiata[a]	*Whole hen's egg*[b]
Lysine	5·20 ± 0·12	8·6
Histidine	5·13 ± 0·01	2·02
Arginine	2·48 ± 0·11	4·42
Aspartic acid	3·37 ± 0·03	8·1
Threonine	3·69 ± 0·04	4·00
Serine	2·44 ± 0·11	6·72
Glutamic acid	7·98 ± 0·[illegible]	10·1
Proline		4·40
Glycine	[illegible] ± 0·01	2·22
Alanine	2·77 ± 0·31	4·00
Valine	2·00 ± 0·20	5·34
Methionine	1·25 ± 0·11	2·13
Isoleucine	2·53 ± 0·20	4·08
Leucine	5·07 ± 0·43	6·90
Tyrosine	1·78 ± 0·22	2·66
Phenylalanine	2·09 ± 0·12	3·78
Tryptophan	—[d]	1·63

[a] Results of four determinations ± SD.
[b] Mba (1980).
[c] Detected, but too small to be evaluated.
[d] Not determined.

TABLE 5
Protein Efficiency Ratio (PER), Net Protein Retention (NPR), Net Protein Utilization (NPU), True Digestibility (TD) and Biological Value (BV) for 10% Protein *Egreria radiata* (Clam) Diet Compared with 10% Whole Hen's Egg Diet in Rat Bioassays

	Egreria radiata (*Clam*)	*Whole hen's egg*[a]
Number of rats[b]	10	10
PER (± SD)	2·55 ± 0·35	3·5 ± 0·2
NPR (± SD)	3·55 ± 0·44	[c]
NPU (% ± SD)	65·7 ± 1·80	90·1 ± 1·1
TD (% ± SD)	85·3 ± 3·90	98·2 ± 1·6
BV (% ± SD)	77·1 ± 3·35	91·8 ± 0·7

[a] Umoh *et al.* (1980).
[b] Five males and five females of average body weight 53·39 ± 2·74.
[c] Not reported.

foodstuff. It is predictable that a higher consumption of this foodstuff over the present levels in the diets of the peasants would go a long way to alleviate some of their nutritional problems.

REFERENCES

AOAC (1975). *Official methods of analysis.* (12th edn), Association of Official Analytical Chemists, Washington, DC.

Bender, A. E. & Doell, B. H. (1957). Biological evaluation of proteins: A new concept. *Brit. J. Nutr.*, **11**, 140–8.

FAO (1965). *Protein Requirements: Report of a Joint FAO/WHO Expert Group.* FAO Nutritional Studies No. 37, Food and Agricultural Organisation of the United Nations, Rome.

Ifon, E. T. (1980). Biological evaluation of the nutritive value of the millet porridge—A traditional Nigerian weaning food—before and after fortification with soya proteins. *Nutr. Rep. Intl.*, **22**, 109–16.

Mba, A. U. (1980). Chemical composition of some local sources of protein foods for man. *Nig. J. Nutr. Sci.*, **1**, 142–7.

Miller, D. S. & Bender, A. E. (1955). The determination of the net utilization of proteins by a shortened method. *Brit. J. Nutr.*, **9**, 382–8

Mitchell, H. H. (1923–24). A method for measuring the biological value of protein. *J. Biol. Chem.*, **58**, 73.

National Academy of Sciences/National Research Council (1963). *Evaluation of protein quality.* Publ. No. 1100, Washington, DC.

Pellett, P. L. & Young, V. R. (1980). *Nutritional evaluation of protein foods.* The United Nations University, Japan.

Spackman, D. H., Stein, W. H. & Moore, S. (1958). Automatic recording apparatus for use in the chromatography of amino acids. *Anal. Chem.*, **30**, 1190–206.

Umoh, I. B. & Bassir, O. (1977). Lesser known sources of protein in some Nigerian peasant diets. *Fd. Chem.*, **2**, 315–21.

Umoh, I. B., Ayalogu, E. O. & Bassir, O. (1980). Evaluation of the nutritive value of some lesser known protein sources in Nigerian peasant diets. *Ecol. Fd. Nutr.*, **9**, 81–86.

Walsh, L. M. (1971). In: *Instrumental methods for analysis of soils and plant tissues.* Soil Science Society of America Inc. Madison, Wisconsin, USA, 17–37.